

Impaired functional capacity and exacerbation of pain and exertion during the 6-minute walk test in women with fibromyalgia

Redução da capacidade funcional e exacerbção da dor durante o esforço do teste de caminhada de 6 minutos em mulheres com fibromialgia

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Abstract

Background: Fibromyalgia has been associated with physical performance limitations. Additionally, activities of daily living have been reported to be directly associated with the exacerbation of pain and perceived exertion in this patient population. **Objectives:** To compare the performance of a 6-minute walk (6MWT) test in patients with fibromyalgia and controls and to evaluate the relationship between test performance and quality of life, limitations of activities of daily living and physical activity level. **Methods:** The study included 19 women with fibromyalgia (FM) and 20 healthy controls (CG). A 6MWT was conducted and pain intensity and perceived effort (PE) were assessed during the test. In addition, Fibromyalgia Impact Questionnaire (FIQ), Health Assessment Questionnaire (HAQ) and International Physical Activity Questionnaire (IPAQ) were applied. **Results:** The fibromyalgia group walked significantly shorter distances when compared to the control group (FM: 473.52±77.84 m vs. CG: 541.75±85.62 m; p=0.02). In the fibromyalgia group, there was a negative correlation between distance in 6MWT and FIQ (r=-0.46; p=0.05), HAQ (r=-0.49; p=0.03) and oxygen consumption (r=0.78; p<0.01). There was also a correlation between HAQ and oxygen consumption (r=0.52; p=0.02). Participants with fibromyalgia had higher pain intensity and perceived effort during the test when compared to the control group. **Conclusions:** Women with fibromyalgia had greater impaired functional capacity, exacerbation of pain and exertion during the 6MWT when compared to healthy women.

Keywords: chronic pain; six-minute walk test; functional capacity; fibromyalgia; physical therapy.

Resumo

Contextualização: A fibromialgia (FM) parece limitar o desempenho físico, e a realização de atividades da vida diária (AVDs) pode exacerbar a dor e o esforço percebido nesses pacientes. **Objetivos:** Comparar o desempenho do teste de caminhada de 6 minutos (TC6) entre pacientes com FM e controles e verificar relações entre esse desempenho com o impacto na qualidade de vida, na realização de tarefas da vida diária e no nível de atividade física. **Métodos:** Participaram do estudo 19 mulheres com FM e 20 mulheres saudáveis. Realizou-se o TC6 e, durante o teste, foram mensuradas a intensidade de dor e a percepção subjetiva de esforço (PSE). Foram aplicados o *Fibromyalgia Impact Questionnaire* (FIQ), *Health Assessment Questionnaire* (HAQ) e o *International Physical Activity Questionnaire* (IPAQ). **Resultados:** O grupo de mulheres com FM percorreu menor distância no TC6 (pacientes: 473,52±77,84 m versus controles: 541,75±85,62 m; p=0,02). Para o grupo de pacientes houve correlações entre a distância caminhada e o questionário FIQ (r=-0,46; p=0,05), o HAQ (r=-0,49; p=0,03) e o consumo de oxigênio (r=0,78; p<0,01) e entre o HAQ e o consumo de oxigênio (r=0,52; p=0,02). Durante o teste, as mulheres com FM apresentaram aumento da intensidade dolorosa e da PSE, o que não ocorreu no grupo controle. **Conclusões:** Mulheres com FM apresentaram comprometimento da capacidade funcional e exacerbção da dor e esforço durante o TC6.

Palavras-chave: dor crônica; teste de caminhada de 6 minutos; capacidade funcional; fibromialgia; fisioterapia.

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Introduction

Fibromyalgia (FM) is a chronic painful syndrome, with unknown etiology¹ and negative repercussions on the work ability, performance of daily functional activities² and quality of life³. Previous studies have demonstrated that functional capacity is compromised in these patients^{4,5}, although only few studies have investigated the influence of the physical activity level on function.

Tests based on physical performance are commonly used to discriminate and quantify difficulties in body functions⁵, although they have greater validity in evaluating functional capacity. The six minutes walk test (6MWT) is a simple, safe and low cost test⁶ that has gained important attention in the clinical and scientific fields^{7,8}. The 6MWT has already been used in previous studies of patients with FM and has shown to have good reliability^{5,9}. The 6MWT has good applicability, because it evaluates, in a global way, the integration of responses of all physiological systems involved in the performance of the exercise¹⁰. The distance walked during the 6MWT has been suggested to reflect the ability to performed activities of daily living (ADL) because, in general, ADL are performed at submaximal levels^{6,10}. The test is also indicated for the evaluation of cardiorespiratory aptitude¹⁰ as previous studies have reported correlations between the distance walked and oxygen consumption ($r=0.51$ to 0.90)¹¹. In patients with FM this correlation have been reported to be 0.65, indicating that the performance in the test may evaluate some aspects of cardiorespiratory aptitude¹².

Patients with FM have been reported to walk shorter distances in the 6MWT when compared with healthy individuals^{4,13}. Although the distance walked is shorter, it is difficult to conclude if test performance is associated with pain or fatigue. There is little evidence on the relationship of the test and ADL performance. Additionally, equations developed based on the 6MWT to predict performance in the general population and to predict oxygen consumption in patients with FM have not been used as clinical parameters for the evaluation of functional capacity in women with FM.

The objectives of this study were to compare the 6MWT performance in women with FM and healthy controls, considering the obtained distance and the predicted distance; to compare the cardiorespiratory aptitude, indirectly, between patients and controls; to evaluate pain behavior and the perceived effort (PE) during the 6MWT and to identify associations between the 6MWT performance and performance of daily activities, the impact of FM on quality of life and physical activity level.

Methods

Study design and identification of subjects

This was a cross-sectional, comparative descriptive study, approved by the Ethics in Research Committee of the Hospital das Clínicas of the Universidade Federal do Paraná (HC/UFPR), Curitiba, PR, Brazil, following the guidelines proposed in the resolution 196/96 of the National Health Council on researches involving humans, protocol number CEP/HC: 1469.137/2007-06.

Patients diagnosed with FM, according to the American College of Rheumatology¹, from the Rheumatology Clinic of HC/UFPR were invited to participate in the study.

Inclusion and exclusion criteria

Women with the diagnosis of FM, aged between 20 and 50 yrs and with body mass index (BMI) between 18.5 and 39.9 kg/m² were included. The exclusion criteria were heart diseases, non-treated pulmonary diseases, osteoarthritis, rheumatoid arthritis, tendinitis of lower limbs, osteoporosis, severe musculoskeletal alterations and users of some kind of assistive device to perform daily activities. Inclusion and exclusion criteria were assessed using patients' medical records and through self-reporting.

The final sample of patients with FM was composed by 19 individuals. Based on the characteristics of this patient group, 20 women without the diagnosis of FM, matched by age and BMI with the patients with FM, were invited to participate in the control group. The selection of control group obeyed the same inclusion and exclusion criteria used for patients with FM.

After obtaining informed consent, anthropometric measures and evaluations of FM impact on the quality of life, functional capacity and physical activity level were performed using an interview format.

Anthropometric measures and evaluation of the impact of FM on quality of life

Body mass (digital balance) and height (stadiometer fixed to the wall) were measured according to the *Anthropometric Standardization Reference Manual*¹⁴ for obtaining BMI, and then classified according to the World Health Organization¹⁵.

The translated and validated Brazilian version¹⁶ of the *Fibromyalgia Impact Questionnaire* (FIQ) was used for evaluation of the impact of FM on quality of life. Questionnaire scores range from 0 to 100 and, the higher the score, the greater the impact

on quality of life. Item five of the FIQ (Visual Analogical Scale, 0-10) was used to evaluate pain intensity.

Evaluation of functional capacity

Functional capacity was measured through the *Health Assessment Questionnaire* (HAQ) and the 6MWT.

HAQ was applied in its translated and validated Brazilian version¹⁷. Final scores from 0 to 1 usually represents mild to moderate difficulty, from 1 to 2 represents moderate difficulty to severe disability and from 2 to 3 indicates severe to very severe disability¹⁸.

The 6MWT was performed in a plane corridor of 30 meters in length, following the recommendations of the *American Thoracic Society*¹⁰. One test per patient was performed and the walked distance (D6MWT obtained) in meters at the end of each test was recorded.

The prediction of how long the participants were able to walk was also calculated. For this, two equations were applied, one American⁷ and other Brazilian¹⁹. Thus, it was possible to obtain the predicted distance (D6MWT predicted) and also the performance of the individuals after the test (% of D6MWT predicted). The American equation was applied because it was the first developed to predict performance on 6MWT and to involve the evaluation of a larger sample. The Brazilian equation was used because it probably reflects better the evaluation of exercise capacity of Brazilian patients with some kind of chronic disease¹⁹. Another characteristic indirectly evaluated applying specific equation for patients with FM was the cardiorespiratory condition. King et al.¹² developed an equation in which the result is expressed as peak of oxygen consumption (pVO_2). These authors¹², comparing the 6MWT with the direct method for evaluation of oxygen consumption, observed the following results: $R=0.76$ and $R^2=0.66$.

During the performance of the 6MWT, pain intensity and PE were also measured. Pain intensity was measured through Visual Numerical Scale (0-10). Pain was measured before the beginning of the test (PAIN 0'), in the minute 2 (PAIN 2'), in the minute 4 (PAIN 4') and then at the end of the test in the minute 6 (PAIN 6'). The OMNI scale²⁰ was used to evaluate rating of perceived exertion (RPE), with values ranging from 0 to 10. The measurement of RPE was performed during the minute 2 (RPE 2'), minute 4 (RPE 4') and soon after the end of the test in the minute 6 (RPE 6'). Before the beginning of the test, explanations about the pain that they could feel (widespread and non-localized) were given to the participants. PE evaluated the central (cardiorespiratory aptitude) and peripheral components (located fatigue) before providing a score from 0 to 10.

Evaluation of the physical activity level

The *International Physical Activity Questionnaire* (IPAQ) was used to evaluate physical activity level. This purposed of this instrument is to estimate the habitual physical activity level²¹. The obtained information was related to the frequency and duration of activities, considering the last seven days. In this study, the long version of the questionnaire was used and the sum of the questionnaire components; work, transport, housekeeping and leisure and the sum of walks and tasks with moderate and vigorous intensities were used to calculate level of physical activity. Data are expressed in terms of energy expenditure spent on MET's-minutes/week²².

Statistical analysis

Data were analyzed by the STATISTICA program (STATSOFT Inc., version 7.0). The Shapiro-Wilk test was used to verify the normality of data and the Levene test to verify the homogeneity of the variances when comparing the two groups. Pearson Correlation Coefficient and independent "t" test were used for parametric data and the Spearman Correlation Coefficient and the Mann-Whitney "U" test were used for non-parametric data. The dependent "t" test was performed to compare the distance obtained with the predicted values in the control group and the Wilcoxon for the patient group. To verify the variation of pain and RPE during 6MWT, the Friedman test and ANOVA for repeated measures were used. The significance level was set at $p \leq 0.05$.

Results

The general characteristics of the sample are presented in Table 1. Both groups were similar in relation to the age and anthropometric variables. Patients with FM showed higher pain intensity, lower quality of life and difficulty to perform ADL.

Data referring to the performance of 6MWT are presented in Table 2. In relation to the equation developed by Enright and Sherrill⁷, the comparison between the predicted distance and the obtained distances revealed differences in values both for the control group (obtained: 541.75 ± 85.62 versus predicted: 612.45 ± 47.14 ; $p < 0.01$) and patients group (obtained: 473.52 ± 77.84 versus predicted: 596.38 ± 43.82 ; $p < 0.01$). Using the equation developed by Iwama et al.¹⁹, it was observed that there were no differences in the distance predicted and observed for the control (obtained: 541.75 ± 85.62 versus predicted: 549.54 ± 11.21 ; $p = 0.68$); however, in the patients group, distances predicted were significantly higher than the distances obtained (obtained: 473.52 ± 77.84 versus predicted: 545.22 ± 11.40 ; $p < 0.01$).

Table 1. General characteristics.

	Controls (n=20)			Patients (n=19)			p
	Mean±SD	Median	95%CI	Mean±SD	Median	95%CI	
Age (years)	39.50±6.07	40.00	(36.65-42.34)	41.84±6.18	43.00	(38.86-44.82)	0.24
Weight (kg)	70.97±14.39	73.05	(64.24-77.80)	72.04±9.64	73.30	(67.39-76.69)	0.79
Height (cm)	159.38±6.48	160.50	(156.35-162.42)	159.34±5.15	158.30	(156.86-161.82)	0.98
BMI (kg/m ²)	27.69±5.43	28.84	(25.15-30.23)	28.40±3.89	29.61	(26.53-30.28)	0.51
Pain (0-10)	1.65±2.60	0.00	(0.43-2.86)	7.66±2.04	8.00	(6.68-8.65)	<0.01
FIQ (0-100)	19.84±8.43	19.83	(15.90-23.79)	65.49±16.23	65.61	(57.67-73.32)	<0.01
HAQ (0-3)	0.13±0.27	0.00	(0.006-0.25)	1.69±0.58	1.88	(1.42-1.98)	<0.01

CI=Confidence Interval; BMI: Body Mass Index; FIQ=Fibromyalgia Impact Questionnaire; HAQ=Health Assessment Questionnaire; "t" independent and "U" Mann-Whitney tests were used for comparing groups when variables had parametric and nonparametric distribution, respectively.

Table 2. Comparison of the two groups regarding variables related to 6-minute walk test.

	Controls (n=20)			Patients (n=19)			p
	Mean±SD	Median	95%CI	Mean±SD	Median	95%CI	
Obtained D6MWT (m)	541.75±85.62	540	(501.68-581.82)	473.52±77.84	488.00	(436.00-511.04)	0.02
Predicted D6MWT (m) ⁷	612.45±47.14	614.13	(590.40-634.52)	596.38±43.82	594.21	(575.26-617.51)	0.28
Predicted D6MWT % ⁷	88.82±14.97	89.60	(81.82-95.83)	79.62±13.77	79.04	(72.98-86.26)	0.05
Predicted D6MWT (m) ¹⁹	549.54±11.21	548.62	(544.29-554.79)	545.22±11.40	543.08	(539.72-550.71)	0.24
Predicted D6MWT % ¹⁹	98.55±15.37	98.59	(91.36-105.74)	86.87±14.37	88.95	(79.94-93.79)	0.02
pVO ₂ (ml/kg/min) ¹²	26.00±3.37	25.79	(24.42-27.53)	23.61±3.30	24.22	(22.02-25.20)	0.03

CI=Confidence Interval; D6MWT=6-minute walk test distance; pVO₂=oxygen consumption peak. Prediction equations according to Enright and Sherrill⁷; Iwama et al.¹⁹; King et al.¹²; "t" independent and "U" Mann-Whitney tests were used for comparing groups when variables had parametric and nonparametric distribution, respectively.

The total physical activity level was similar between patients (4094.05±3931.36 MET's-minutes/week) and control groups (3820.65±3205.15 MET's-minutes/week), with significance level of p=0.82.

Table 3 presents the values of correlation (*r*) and significance (*p*) for the correlations between the obtained distance in 6MWT and the other variables of the study for both groups.

During every moment of the 6MWT (minutes: 2, 4 and 6) and before its beginning (minute 0), patients showed higher pain intensity (p<0.01) when compared to healthy controls.

The Friedman test showed that pain intensity was not significantly different between all four moments of the 6MWT in the control group (p=0.34). However, for patients group, the ANOVA test for repeated measures showed that there were differences (p<0.01), and the Tukey post-hoc analysis showed that this difference were between the moments 0 and 4 and 0 and 6. Mean (SD) pain for both groups and comparisons between and within groups are presented in Figure 1.

The RPE during the 6MWT was higher in the patients group (p<0.01) than in the control group at every moment (minutes: 2, 4 and 6). The Friedman test showed that, for control group, there were no differences (p=0.11) in any moment during the test; however, differences existed for the patient group (p<0.01). The Dunn's post-hoc analysis showed that these differences occurred between moments 2 and 6. Mean (SD) RPE for both groups and comparisons between and within groups are presented in Figure 2.

Table 3. Correlation between the 6-minute walk test distances and study variables.

	Patients		Control	
	r	p	r	p
Age	0.11	0.66	-0.22	0.35
Weight	-0.29	0.22	0.08	0.73
Height	0.00	0.99	0.04	0.86
BMI	-0.24	0.32	0.07	0.75
Pain	-0.41	0.08	0.17	0.46
FIQ	-0.46	0.05	0.19	0.43
HAQ	-0.49	0.03	0.16	0.48
Predicted D6MWT (m) ⁷	0.01	0.98	0.12	0.61
Predicted D6MWT % ⁷	0.84	<0.01	0.89	<0.01
Predicted D6MWT (m) ¹⁹	-0.11	0.66	0.22	0.37
Predicted D6MWT % ¹⁹	0.98	<0.01	0.99	<0.01
D6MWT (pVO ₂) ¹²	0.78	<0.01	0.72	<0.01
IPAQ	0.13	0.61	-0.03	0.88

BMI=Body Mass Index; FIQ=Fibromyalgia Impact Questionnaire; HAQ=Health Assessment Questionnaire; D6MWT=6-minute walk test distance; pVO₂=oxygen consumption peak; IPAQ=International Physical Activity Questionnaire. Prediction equations according to Enright and Sherrill⁷; Iwama et al.¹⁹; King et al.¹². Pearson correlation and Spearman correlation tests were used when variables had parametric and nonparametric distribution, respectively.

Correlations between pain and RPE during the minutes 2, 4 and 6 demonstrated non-significant correlations for the control group but a significant correlation in the minute 6 (r=0.77, p<0.01) for the patients group, indicating that at the end of the test, higher pain intensity was related to higher PE.

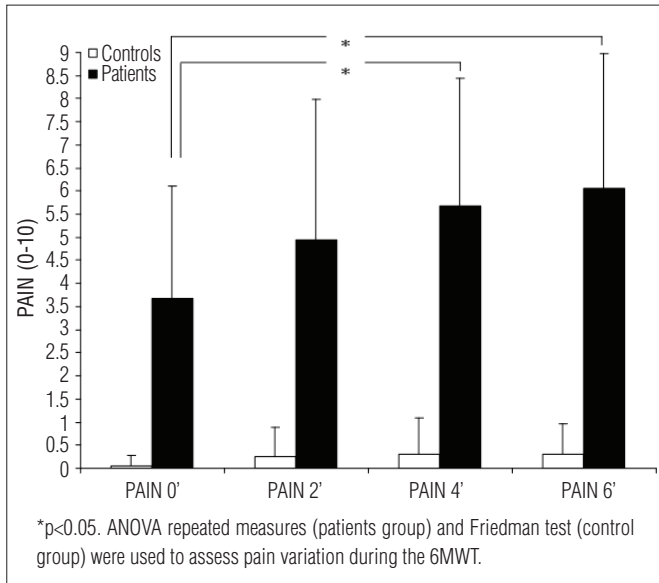


Figure 1. Pain intensity during the 6-minute walk test (6MWT).

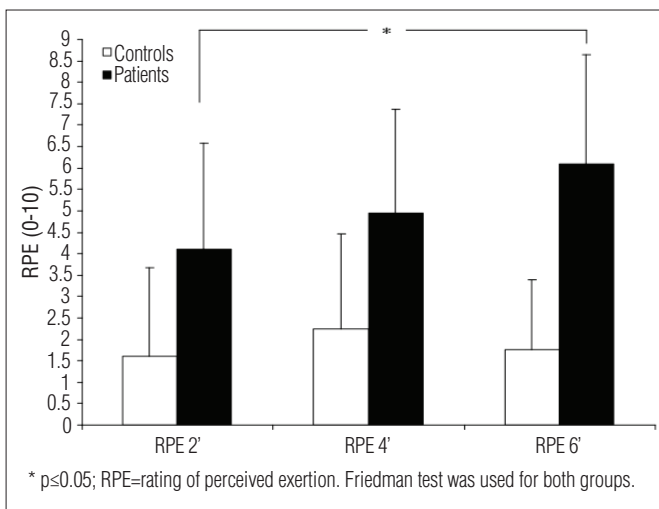


Figure 2. Rating of perceived exertion during the 6-minute walk test.

Discussion

In the present study, the walked distance, the percentage of the obtained distance in relation to the predicted distance and the cardiorespiratory aptitude were lower on the group of women with FM. The performance of the 6MWT showed inverse and significant correlation with quality of life, which compromises patients' performance of ADL. Physical activity level was similar between groups and did not correlate with test performance. Pain intensity and PE was increased during the 6MWT in the group of women with FM but not in the control group.

The 6MWT is a simple, low cost activity that is recommended for functional evaluation in several health conditions¹⁰. In the present study, it was verified that women with FM walked shorter distances than the control group, corroborating

the results of previous studies^{4,13}. The mean walked distance reported in this study was similar to the mean identified in other investigations of the same patient population^{5,9,23}.

In relation to the predicted distance, both groups walked significantly less than the expected according to the equation of Enright and Sherrill⁷. Similar results were reported by Soares et al.²⁴, when they evaluated the applicability of the same equation for Brazilian healthy individuals. As great part of the variability of the observed results, during the application of 6MWT, is due to the population diversity, the use of Brazilian equations²⁵ are suggested. Therefore, the equation proposed by Iwama et al.¹⁹, verified that the control group walked, on average, 98.55% of the expected D6MWT (p=0.68). However, the group of patients with FM walked, on average, 86.87% of the expected (p<0.01), demonstrating functional limitations.

In this study, patient with FM showed lower cardiorespiratory condition when compared with the control group, which is in line with the results of previous studies²⁶. The results of the 6MWT demonstrated high correlation between the calculated oxygen consumption and the obtained distance for both groups. However, there are controversies on the validity of using 6MWT to evaluate cardiorespiratory aptitude. Conflicting results have been found in the literature where some studies have identified a correlation between pVO₂ and distance in 6MWT¹² and other have failed to identify a correlation between 6MWT and cardiorespiratory evaluation²⁷. The differences in the results may be explained by the test protocols used for the direct measure of pVO₂ between both studies.

Pankoff et al.²⁷ applied a treadmill protocol where there was an increase in inclination and speed and King et al.¹² used a protocol where there was only an increase of inclination at each stage, and the speed was chosen by the individual. The later better approximates to the 6MWT were patients can select their own walking speed¹⁰. Supposing that pain may limit the execution speed and the performance in maximum exercise test, 6MWT may be a good alternative for the cardiorespiratory evaluation of patients with FM, when a direct and more specific evaluation is not possible.

Another condition investigated in this study was the relationship of D6MWT with questionnaires that evaluate quality of life and the difficulty in performing daily tasks. The results suggest that, the shorter the distance walked by patients, the higher the negative impact on their quality of life. Similar results were observed in other studies^{12,27}. Although different physiological systems are minimally used in the 6MWT¹⁰, the test still represents a basic daily activity and therefore, lower performance on the 6MWT may represent poorer quality of life.

Function has been an emphasize in the evaluation of quality of life of patients with FM and therefore, was incorporated in elaboration of the new FIQ²⁸. The most recent version of the

questionnaire has undergone modifications and functional capacity now represents 30% of the total score instead of the previous 10%, indicating that function should be deeply considered in the evaluation of the impact of quality of life in patients with FM.

Although the 6MWT is recommended for functional evaluation¹⁰, few studies have investigated its relationship with scales used to evaluate changes in daily activities performance in patients with FM^{5,12,27}. Mannerkorpi, Svantesson and Broberg⁵ reported that there was no consent on which scale would better reflect functional limitation in FM. These authors⁵ observed moderate to strong correlations between 6MWT and three other scales (*Fibromyalgia Impact Questionnaire*, *Medical Outcomes Study 36-item Short-Form Health Survey* and *Arthritis Self-Efficacy Scale*), with the 6MWT contributing to the variation in performance in two of these scales.

A recently published study²⁹ evidenced the relationship between the 6MWT and HAQ and showed that this questionnaire was valid in evaluating the limitations in performance of daily activities, because pain explained a variation of 40% in its score. When pain was associated with the distance walked in the test, this variation increased to 60%²⁹. In a similar way, in the present study, significant correlation between the distance walked in the 6MWT and HAQ was verified ($r=-0.49$; $p=0.03$). Other correlations observed were between the walked distance and oxygen consumption ($r=0.78$; $p<0.01$) and between oxygen consumption and HAQ score ($r=-0.52$; $p=0.02$). These results are indicative that a worst performance in the 6MWT, associated with lower cardiorespiratory aptitude, may limit the performance of ADL.

Recently, Staud et al.³⁰ verified that physical exercise (protocol using an arm ergometer) increased individuals' pain intensity. The authors evaluated pain before and after the exercise. For both groups, there was an increase in pain after exercise during two different sessions. However, the patients group always showed higher pain intensity at all moment of the evaluation. In the present study, there were also differences between the two groups at every moment of pain evaluation. In the patients group, pain increased significantly during the exercise with no significant increase in the control group. This response evidences that pain intensity is exacerbated and maintained by the muscular stimulus generated during the practice of some physical activity in women with FM, as also suggested by other authors³¹.

In the present study, PE increased significantly at the end of the test with comparison to the initial phase only in the FM group. These results demonstrate that the exercise was deemed extenuating by patients during its execution. In the study of Staud et al.³⁰ there were no differences between women with FM and control at any moment of the evaluations, even with

the use of load on the upper limb, during the execution of the test, in both groups. This was different from our study, in which patients could dose their rhythm and were able to maintain constant intensity during the exercise without incremental adjustments and the addition of load. Nevertheless, this protocol probably still represented stress load during the execution of gait in the patients group.

Pierrynowski, Tiidus and Galea³² evaluated the gait pattern in patients with FM and observed a pattern of muscle recruitment internally different from the one of healthy people. Specifically, they use their hip flexors instead of the ankle plant flexors at the moment of leaving the foot of the soil, as compensatory mechanism to sustain a pattern. The authors³² suggested that, due to the strategy used in gait by women with FM, the motor control system interprets this comfortable task as extenuating. In the present study, patients walked shorter distance in the 6MWT than healthy controls and they reported higher scores for PE during the test and after the test.

As observed, the group with FM showed worse functional performance than the control group. However, the physical activity level was similar between the two groups and not significantly associated with the results of the 6MWT. Thus, other factors such as exacerbation of pain and perception of these patients in relation to the accomplished effort may interfere in the execution of the daily functional activities.

This study had some limitations with relationship to the sample size, however well delineated inclusion and exclusion criteria were set, which hindered the recruitment of a higher number of individuals with FM. The results demonstrated that the group with FM showed impaired functional capacity. However, the observed findings may not be extrapolated for all individuals with FM, because only women were evaluated; additionally the sample was recruited from a single hospital only.

Conclusions : : : .

Women with FM showed worse functional capacity evaluated using the 6MWT and greater compromise of the performance of ADL when compared with healthy women with the same physical activity level. During the 6MWT performance, the group of women with FM showed increased pain intensity and PE, fact that did not occur in the control group.

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